DEPARTMENT OF THE INTERIOR—U. S. GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

TIMBER CONDITIONS

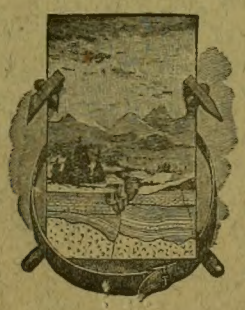
IN THE

PINE REGION OF MINNESOTA

BY

H. B. AYRES

EXTRACT FROM THE TWENTY-FIRST ANNUAL REPORT OF THE SURVEY, 1899-1900
PART V, FOREST RESERVES—HENRY GANNETT, CHIEF OF
DIVISION OF GEOGRAPHY AND FORESTRY



WASHINGTON
GOVERNMENT PRINTING OFFICE
1900

TIMBER CONDITIONS OF THE PINE REGION OF MINNESOTA

BY

H. B. AYRES

21 GEOL, PT 5——43

CONTENTS.

ILLUSTRATION.

TIMBER CONDITIONS OF THE PINE REGION OF MINNESOTA.

By H. B. Ayres.

BOUNDARIES.

The pine lands of Minnesota, as indicated by the earliest surveys, extended to the State line on the north and east, while southward they merged into the hardwood "park region" along the southern lines of Pine and Kanabec counties. Thence westward the irregular border passed near Milaca, Little Falls, and Wadena to Frazer City and northward to the western extremities of Red Lake and Lake of the Woods.

SPECIES.

The trees composing this forest are:

Species found in pine region of Minnesota.

White pine	Pinus strobus Linn.
Jack pine	Pinus divaricata (Ait.) Du Mont de Cours.
Norway or red pine	Pinus resinosa Ait.
Tamarack	Larix laricina (Du Roi) Koch.
White cedar	Thuja occidentalis Linn.
Red cedar	Juniperus virginiana Linn.
Black spruce	Picea mariana (Mill.) B. S. P.
White spruce	Picea canadensis (Mill.) B. S. P.
Balsam	Abies balsamea (Linn.) Mill.
Hemlock	Tsuga canadensis (Linn.) Carr.
Aspen	Populus tremuloides Michx.
White poplar	Populus grandidentata Michx.
Balm of Gilead	Populus balsamifera Linn.
White birch	Betula papyrifera Marsh.
Yellow birch	Betula lutea Michx. f.
Hard maple	Acer saccharum Marsh.
Red maple	Acer rubrum Linn.
White maple	Acer saccharinum Linn.
Basswood	Tilia americana Linn.
Red oak	Quercus rubra Linn.
Burr oak	Quercus macrocarpa Michx.
White oak	Quercus alba Linn.
Scarlet oak	Quercus coccinea Muenchh.

Black ash	Fraxinus nigra Marsh.
White ash	Fraxinus americana Linn.
White elm	Ulmus americana Linn.
Rock elm	Ulmus racemosa Thomas.
Slippery elm	Ulmus pubescens Walt.
Ironwood	Ostrya virginiana (Mill.) Koch.
Hackberry	Celtis occidentalis Linn.
Butternut	Juglans cinerea Linn.
Hickory (pig nut)	Hicoria minima (Marsh.) Britton.
Black cherry	Prunus serotina Ehrh.

TIMBER TREES.

The trees now used for lumber are, in order of the amounts cut:

Timber trees in pine region of Minnesota.

1. White pine.	5. Jack pine.	9. Yellow birch.
2. Norway pine.	6. White elm.	10. Hard maple.
3. Burr oak.	7. Tamarack.	11. White poplar.
4. White spruce.	8. Basswood.	12. Rock elm.

Of these twelve, but three, white pine, Norway pine, and burr oak, have been of commercial importance.

Tamarack has been extensively used for railway ties. Cedar is used in large quantity for poles, posts, and ties. A small amount of jack pine is cut and sold with Norway pine as lumber and many ties are made of it for branch railroads, but its principal use is for fuel.

Spruce and a small quantity of aspen are used for pulp.

Yellow birch, hard maple, basswood, ash, etc., are utilized for lumber when accessible, but trees suitable for lumber are much scattered, and until recently land owners or buyers have paid little attention to hardwood.

Most lumbermen have ignored everything but pine, but some have estimated it in cords as fuel.

DISTRIBUTION.

The trees have their preferences as to soil, subsoil, and exposure, but there is so little difference in large areas and so much variety on almost every 40-acre tract that, excepting the larger tracts of sandy lands and muskegs, the classes are so intermingled that they can not be differentiated on a map.

White pine, like all other trees, grows best in deep, porous, moist, fertile soil, and in this region the effect of the climate and the fires have often enabled it to establish itself on the best of the land in competition with species which in milder climate and freedom from fires would have crowded it out.

While Norway pine and jack pine enjoy good soil, they find most favorable starting places on sandy and gravelly lands, occasionally

fire-swept, such as the triangular tract of which Sturgeon Lake is the center and the large crescent-shaped area extending from Brainerd to Red Lake.

Burr oak also likes a porous soil and is found as a timber tree on the borders of the pine land and on alluvial banks and bottoms. On shallow soils, with hard clay subsoils, this species becomes a scrub oak, notably on the bowlder clays west of Park Rapids. Basswood and maple are found on the very best uplands. Yellow birch, red oak, aspen, white birch, and others are found on the medium quality or inferior clay lands. Tamarack thrives on the loamy borders of swamps, while black spruce is seldom found on dry land, but usually borders and reaches out slightly upon the muskegs.

Within the borders indicated the only natural treeless areas are muskegs or swamps and the few small prairie openings or parks in the western portion.

EXPLANATION OF MAP.

A very prominent feature of the Minnesota pine forest is its variety. The so-called original forest, or the forest found by the earliest whites, was a complicated patchwork of kinds and conditions due to a great variety of surface and soil, to the ceaseless strife between the thirty-nine species of trees composing it, and to the effect of ever-varying fires. Incidentally, the white man has greatly increased this variety of conditions by cutting, burning, and clearing.

Some of the lines between the differing classes of forest are sharp and distinct, but most of them are indefinite. Some areas of each class are extensive, but many of them are very small and irregular in outline.

To make a map showing such small details and such interlapping and blending areas is impractical, not only because of the impossibility of printing such a map, but also because of the expense of collecting such minute data. Furthermore it would not be good policy to publish a statement of the amounts and exact locations of standing timber which timber thieves could use. Therefore the information collected has been generalized to show the proportions of original forest remaining, the approximate amount of standing pine timber, the areas of stump land, and the land burned before cutting.

In presenting this information on the map the principal color has been used to represent the more important feature of the forest and the subordinate colors to show as nearly as possible the proportion of the classes they each represent.

For example, a township is reported as cut over, with 10,000,000 feet of pine left. This township is colored yellow and dotted with green, the green representing not the exact location but the general proportion of standing timber. Again, where lines in the forest are

indefinite, and classes blend or natural borders fade into one another, the lines must on the map be drawn sharp in order to print them. The details of the actual condition are thus lost, but the proportions are believed to be approximately correct.

An unavoidable source of inaccuracy lies in the fact that some of the land has not been thoroughly explored and estimated. Some thirty townships are yet unsurveyed, and while they have been looked over in a general way by timbermen, the estimates do not cover all the land, and are intended to be less than the actual cut or "safe estimates."

Former estimates of the amount of pine-log timber in the State have been small for the same reason. The amounts stated were the amounts known, and a large discrepancy often occurred in making allowance for the unexplored areas. It is quite possible that the present estimate may prove less than the cut, especially if fires are effectually checked and natural growth be permitted to increase by normal annual accretions the size of the trees now standing.

ESTIMATES.

In making up the present estimate it was found that the county records were of no use, but were rather misleading, with the few exceptions where special assessments had been made, as in parts of Itaska, Hubbard, and Lake counties. Large areas were found assessed at a uniform valuation, ranging from $1 to $3 per acre, whether timbered or stump land, pine, hardwood, or open bog.

The areas assigned to assessors are often so large that it is impossible for them to make a proper estimate of timber with the funds set apart for their remuneration.

The reports of lumbermen and pine-land owners have been equally unsatisfactory for several reasons. Their lands are not in large, continuous tracts, but are isolated selected 40-acre lots, chosen on account of the pine on them from the lands vacant or purchasable at the time. Being picked areas, they do not represent the average, and their estimates can apply only to the tracts on which they were made.

A serious difficulty was due to the great number of small holdings and the distant residence of the owners. This, combined with their business reasons for not making known the amount of pine on their lands, has rendered the collection of data from the owners impractical.

The most satisfactory class of information has been that furnished by cruisers who have estimated standing timber or looked after cutting in their several regions. The estimates obtained from them have not in all cases been a summary of their own cruisings, but are partly rough estimates, based on their general knowledge, in order to cover the intermediate ground they have not cruised.

The need of careful estimates and appraisals by township assessors, in order to levy a just taxation and furnish accurate knowledge of the

forest, is keenly felt by the owners and other taxpayers as well as by those who are studying the maintenance of the forest.

In the following table the attempt is made to show approximately the amount of forest material left in the pine region. In preparing it especial care was taken to avoid making estimates on an imperfect basis, such as applying an average of lands held by one person (selected areas) to any large contiguous area. Openings, swamps, sapling and hard-wood tracts must be averaged with these selected areas to secure a fair factor for the whole region.

Table showing timber remaining in pine region of Minnesota.

County.	Log timber (million ft. B. M.).			Pulp wood (thousand cords).		Fuel (thousand cords).	
	White pine.	Norway pine.	Hard wood.	Spruce.	Aspen.	Hard.	Soft.
Cook	900	100	500	500	1,000	5,000	900
Lake	1,400	1,000	500	1,000	3,000	10,000	1,000
St. Louis	3,440	1,500	650	3,000	8,200	18,000	2,000
Itasca	1,500	800	400	3,000	8,000	17,000	3,000
Beltrami	1,400	500	200	1,000	4,000	8,000	2,000
Norman	50	10	5	1	100	280	20
Becker	230	50	30	5	400	2,000	500
Ottertail	3	2	80	.5	100	800	10
Wadena	6	12	10	1	50	1,000	10
Hubbard	300	350	10	1	1,000	1,000	3,010
Cass	850	300	100	500	2,000	1,000	5,000
Crow Wing	40	20	20	200	2,000	1,000	3,000
Aitkin	160	40	50	1,000	3,000	10,000	1,000
Carlton	250	50	30	70	500	2,000	800
Pine	450	50	30	30	400	3,000	700
Kanabec	70	10	10	10	200	1,000	200
Millelacs	130	20	110	5	100	1,000	300
Morrison	10	4	45	5	130	500	800
Benton	1	1	10		2	1,100	
Total	11,190	4,819	2,780	10,328.5	34,182	73,680	24,250

In comparison with the estimate of standing timber made by the Minnesota chief fire warden in his annual report for the year 1896, viz, white and Norway pine, 20,666,475,000 feet B. M., the present estimate for 1899 of 16,009,000,000 feet B. M. is less by 4,257,475,000 feet B. M. This difference is not far from the cut of the intervening years, and as these two estimates were made independently by summing detailed data collected by extensive canvass, it seems that the amount of standing timber has been learned as accurately as possible by the

methods employed. As suggested elsewhere in this article, township assessors might, at small additional cost in making their assessments, collect such data and make our knowledge of such lands much more accurate. The estimate would thus be revised with each assessment.

CLASSIFICATION OF FOREST LAND.

The following table serves to show the general condition of the forest with reference to cutting and burning, with the explanation that about 90 per cent of the stump lands are burned and that much of the so-called virgin forest has been burned and is now in the various stages of restocking. Much of this area is mere brush, and some of it is open slough, muskeg, or meadow, which it has been impracticable to separate.

Large areas have been burned over and large amounts of log timber have been killed and lost, of which there is no record and no evidence. The fires occurred years ago and these lands are now classed as cut over, because the timber trees that survived have since been cut.

Classification of forest land in pine region of Minnesota.

County.	Original forest.	Stump lands.	Known to have been burned before cutting.
	Square miles.	*Square miles.*	*Square miles.*
Cook	1,277	4	240
Lake	2,237	90	230
St. Louis	2,520	1,810	2,232
Itasca	3,744	1,160	576
Beltrami	924	400	2,160
Norman	20	.....	144
Becker	108	430	216
Ottertail	None.	260	Not recorded.
Wadena	None.	400	40
Hubbard	228	500	324
Cass	504	1,260	400
Crow Wing	20	1,080	Not recorded.
Aitkin	70	1,800	Not recorded.
Carlton	55	790	*a* 14
Pine	63	1,000	Not recorded.
Kanabec	20	580	Not recorded.
Millelacs	82	280	Not recorded.
Morrison	10	400	Not recorded.
Benton	None.	40	Not recorded.
Total	11,882	12,684	.....

a Partly recorded.

FOREST HISTORY.

Where undisturbed by cutting, the forest of to-day differs from that of a hundred years ago only as affected directly or indirectly by fire. The oldest woods are fire scattered, especially where composed of young or middle-aged pine, having large trees scattered among it. These large trees have almost invariably been marked by fire at a date older than the younger portion of the forest.

In the so-called original forest the scarred veterans of old fires standing high above the common woods form a prominent feature of the landscape.

Only a portion of the old burns were restocked with pine, however, for large areas severely burned and without seed trees were occupied by aspen and birch and are as yet very scantily timbered.

FIRES.

Thus it is seen that fires are not a novelty in these old woods, but have for hundreds of years been a prominent factor in their history. The coming of the whites and the general distribution of trappers and "couriers du bois" through the woods by the Hudson Bay Company and the American Fur Company 100 to 140 years ago seem to have been prolific of fires, for a very large proportion of the trees of the older uniform forests are 100 to 140 years of age, and must have started during that period. Later fires, especially those of 1840 north of Red Lake, those of 1860 and 1878 northeast of Tower, and the general fire of 1894, have been very destructive, and since lumbering began large areas untouched by the ax have been reduced by fire to brush land, on which stubs and stumps of the former forest are abundant.

In the Seventh Annual Report of the Geological and Natural History Survey of Minnesota, Prof. N. H. Winchell says:

> During the season [1878] all parties connected with the survey have had occasion to note the frequent and wanton destruction of the native forests by fire. It is estimated that annually ten times as much pine is destroyed in the State as is cut by all the mills. A large part of the triangle north of Lake Superior has been thus devastated. The State has lost in this way more than as much pine as now remains.

On the western border of the pine forest from Red Lake to Becker County and southeastward to Brainerd, fires have been frequent and severe. In this region pine is usually found in clumps that have escaped the killing fires. The trees in these clumps are scorched and partly killed, while the intermediate areas are open and brushy, with many remains of large pine trees. The amount of pine log timber lost by these fires has been enormous, even within the memory of lumbermen. Where accessible, much of the log timber can be used immediately after being killed by fire, but in remote and undeveloped territory losses have been very heavy, as the timber killed has necessarily been wasted. Only a small proportion of such losses has been

estimated or recorded, but the following notes illustrate some of the damage:

Damage from fire in pine region of Minnesota.

Date.	Locality.	Killed.
		Feet B. M.
1889	T. 144 N., R. 39 W.	25,000,000
1894	T. 148 N., R. 38 W.	9,600,000
1894	T. 149 N., R. 38 W.	55,740,000
Various fires	T. 143 N., R. 37 W.	105,000,000
Do	T. 145 N., R. 38 W.	10,000,000
Do	T. 144 N., R. 37 W.	165,000,000
Do	T. 145 N., R. 37 W.	55,000,000
Do	T. 146 N., R. 37 W.	97,000,000
Do	T. 146 N., R. 38 W.	25,000,000
Do	T. 144 N., R. 31 W.	122,000,000
Do	T. 144 N., R. 32 W.	22,000,000
Do	T. 144 N., R. 30 W.	70,000,000
Do	T. 144 N., R. 29 W.	45,000,000
Do	T. 144 N., R. 27 W.	90,000,000

In these 14 townships there has been a known loss of 836 million feet, which to-day would have been worth on the stump $3,344,000, or an average of some $240,000 to each township.

Fires have been very destructive in the northern part of the State also. A large proportion of the area north of Red Lake and eastward to Lake Superior (several thousand square miles) has been reduced to brush land, and several thousand acres are now bare rock on which dead stubs and partly burned roots show that timber once grew. The areas burned over, killing the timber before cutting, are now undeterminable. Those now known and shown on the map are but a fraction of the whole. The area of these amounts to about 4,760 square miles. There is no way of closely estimating this amount. Roughly, it may be assumed that this land averaged probably 2,000 feet per acre, or 1,280,000 feet per square mile. The amount killed was probably 8 billion feet.

In considering the damage by fires it should be remembered that only a small portion of severely burned lands are soon restocked with timber trees. This fact is illustrated by the condition of the old forest, most of which was probably seeded on burns. The yield on such land seldom exceeds 10,000 feet B. M. per acre (though 100,000 feet have been cut on exceptional acres), and there are large areas that do not average more than 1,000 feet per acre. Some 14,000 square miles of original forest in the northern part of the State will not average 3,000

feet of pine per acre, and it is probable that the average yield for the whole pine region has been about this figure. The difference between this figure and 10,000 feet per acre, which would be only a moderate possible stand for white and Norway pine, may with reason be attributed to the effect of fires.

FIRES ON STUMP LAND.

Stump land is seldom found unburned. It is roughly estimated that 90 per cent of the cut-over land in the State has been overrun by fire. In such burning most of the seeds, seedlings, and seed trees are killed.

Where fires have been moderate and some seed trees survived, a new stand of pine sometimes appears, but where severe the fires are followed by aspen, birch, scrub pine, or brush.

The loss in burning stump land is usually greatly underestimated. Much of the land immediately after cutting has many saplings, which in a few years would make timber and seed trees. Fires kill these and render the land nonproductive, or at least greatly reduce the product.

Perhaps the best way to estimate the damage is to consider the difference between fairly stocked land yielding 10,000 feet per acre and fire-swept land yielding nothing. About one hundred years are required to produce a crop of 10,000 feet per acre. This means an average annual growth of 100 feet B. M., or 40 cents' worth of log timber, per acre each year, besides fuel, etc. This amount, though small, is in contrast with lands going delinquent for taxes, the common rate of taxation being about $7\frac{1}{2}$ cents per acre. In the pine region of the State there are about 1,000,000 acres of land on which taxes are delinquent.

In tabulating the delinquent lists it is quite noticeable that a great proportion of delinquent lands are in the old pineries, where soil is light. The delinquent lands in Cass County number 116,000 acres; in Crow Wing County, 68,000 acres, and in Millelacs County, 80,000 acres. Where exhausted forests and collapsed real estate booms have both occurred the highest proportion is found, as in Carlton County, where the delinquent lands amount to 106,000 acres, or nearly 20 per cent of the area of the county.

FIRE PROTECTION.

The present system of fire protection is unquestionably a great check upon fire, but the few years that have passed since its inauguration are not sufficient to show exactly what its effect will be after the fear of the people, excited by the fires of 1894, subsides and a very dry season occurs. The present system is too much under local influence.

NEW GROWTH.

On burned stump land the principal stock is aspen. Among this are white birch and scrub pine, with other species and brush in mixture. The reappearance of white and Norway pine on severe burns is rather unusual.

VALUE OF STUMP LAND.

In considering the value of stump land, a comparative view of the areas cut over, the areas improved, and the areas on which taxes are delinquent serves to show the waste or misuse of land that might be growing timber until needed for agriculture.

Comparative table showing use of stump land in the pine region of Minnesota.

County.	Areas of pine forest.	Areas cut over.	Areas assessed as improved.	Areas on which taxes are delinquent.
	Square miles.	*Square miles.*	*Square miles.*	*Square miles.*
Cook	1,520	4	.....	.....
Lake	2,380	90	0.42	15.68
St. Louis	5,860	1,810	8.84	134.37
Itasca	5,430	1,160	19.62	113.62
Beltrami	5,040	400	.39	31.60
Becker	720	430	131.40	*a* 99.28
Ottertail	260	260	.....	.....
Wadena	460	400	55.23	*a* 35.12
Hubbard	1,000	500	117.19	25.06
Cass	2,990	1,260	9.30	179.75
Crow Wing	550	1,080	33.40	103.25
Aitkin	1,900	1,800	.....	110.68
Carlton	860	790	115.00	163.81
Pine	1,400	1,000	.....	77.56
Kanabec	522	580	6.70	16.56
Todd	280	280	.....	.....
Millelacs	580	400	.....	121.56
Morrison	400	400	135.10	80.62
Benton	40	40	73.35	35.30
Total	32,192	12,684	.....	.....

a Mostly agricultural.

It should be remembered that not all the improved lands are assessed as improved; only those that have been deeded from the Government. On the other hand, in the forest the areas of improved lands not deeded are very small; seldom over 3 acres; merely a garden patch.

With this table it would be very interesting to compare the areas of entered lands and to note the great discrepancy between the amount of forest land bought or entered (much of it "homesteaded") by individuals and the amount actually improved by agricultural use.

Of the land from which the timber has been cut off 90 per cent is burned over and lies waste, while the remainder is utilized in agriculture.

If forest land is to be farmed, the farming should begin immediately after cutting, as with such practice the land would not lie idle, and that would be the easiest time to clear the land.

INDEX.

J.

Q.

O

U.S. GEOLOGICAL SURVEY

PINE REGION OF MINNESOTA

SHOWING CLASSIFICATION OF LANDS

Compiled under the direction of Henry Gannett, Geographer in charge

BY H. B. AYRES

1899

Scale

10 0 10 20 30 40 MILES

LEGEND

PRAIRIE | HARDWOOD | ORIGINAL FOREST PINE LESS THAN 2000 FEET B.M. | ORIGINAL FOREST PINE 2000-3000 FEET B.M. | PINE CUT 50 PER CENT BURNED OVER | BURNED BEFORE CUTTING | DRY SWAMP PRAIRIE